Capability Replacement Laboratory

325 Building Extended-Mission Risk Assessment

CRL-RPT-ESH-001, Revision 0

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

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325 Building Extended-Mission Risk Assessment

CRL-RPT-ESH-001, Revision 0

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Executive Summary

The Physical Sciences Facility (PSF) Project was requested to address the "risk" to the U.S. Department of Energy (DOE) – Office of Science (SC) in accepting responsibility for the 325 Building safety basis. In support of this request, the facility and project coordinated several extensive assessments specific to structures, systems, and components that are either safety related or integral to extended facility operations that would or could have an impact to the operations or safety basis for the facility. The composite result of these assessments is as follows:

The risk of continued operation of the 325 Building for an additional 20 years is low:

- The comprehensiveness of the assessments provide high confidence that the identified facility, system, and documented safety analysis (DSA) modifications and upgrades will provide for safe operation of the 325 Building for the extended 20-year mission. The risk to the public is not expected to approach evaluation guidelines (25 rem), the risk to the onsite worker is expected to be well below the evaluation guidelines (100 rem), and the risk to the facility worker is expected to be low.
- All facility, system and DSA modifications proposed in these assessments have been incorporated into the PSF Project scope. No additional cost-beneficial modifications have been identified.
- No other major investments are anticipated for the 325 Building in the out years. Routine and preventive maintenance of the facility will be funded through annual operating budgets.
- The upgraded DSA will meet SC expectations for a hazard category-2 nuclear facility.

The risk of continued operation of the 325 Building under the existing safety basis until the upgraded safety basis is implemented is low:

- The safety basis control strategy for the upgraded DSA is expected to be essentially the same as the existing DSA with only minor changes: 1) designation of the hot cell and glove box structures as passive safety significant (SS) design features and 2) implementation of specific administrative controls (SACs).
- Existing 325 Building technical safety requirements and safety management programs already implement the intent of anticipated new SS design features and SACs.
- There will be no discernable differences in the calculated dose to the maximum offsite individual and to the onsite worker between the current DSA and the upgraded DSA.
- The risk to the facility worker is improved with the upgraded DSA, primarily from designation of the hot cell and glove box structures as passive SS design features.

This assessment further concluded that the comprehensive set of planned facility modifications does not represent a substantial change to the existing safety basis and is, therefore, not a "major modification" per 10 CFR 830. While an analysis of project risks showed high confidence that the PSF Project will meet project schedule and cost performance requirements, a decision by DOE that these modifications are indeed a "major modification" would result in a substantial delay in completing the modifications in order to allow for development and approval of a preliminary documented safety analysis and for the conduct of an operational readiness review.

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Acronyms

AC	administrative controls
ANSI	American National Standards Institute
CAM	continuous air monitors
CAS	criticality alarm system
CD	critical decision
CFR	Code of Federal Regulations
CRAD	criteria review and approach document
DAC	derived air concentration
DBE	design basis earthquake
DF	design features
DID	defense in depth
DNFSB	Defense Nuclear Facility Safety Board
DOE	Department of Energy
DSA	documented safety analysis
EM	DOE Office of Environmental Management
F&O	Facilities and Operations
FY	fiscal year
GFE	government furnished equipment
HA	hazard analysis
HC	hazard category
HEPA	high efficiency particulate air
HLRF	high level radiochemistry facility
HVAC	heating ventilation and air conditioning
ISMS	Integrated Safety Management System
LCO	limiting conditions of operations
NPH	natural phenomena hazards
ORR	operational readiness review
PDSA	preliminary documented safety analysis
PNNL	Pacific Northwest National Laboratory
PNSO	Pacific Northwest Site Office
PSF	Physical Sciences Facility

R&D	research and development
RA	readiness assessment
REVS	radioactive exhaust ventilation system
RL	DOE Richland Operations Office
SAC	specific administrative controls
SAL	Shielded Analytical Laboratory
SC	DOE Office of Science
SDS	safety design strategy
SMP	safety management programs
SS	safety significant
SSA	safety system assessment
SSC	structures systems and components
TPC	total project cost
TSR	technical safety requirements
USQ	unreviewed safety question

1.0 Introduction and Purpose

The total project cost (TPC) for the original Critical Decision (CD) – 1 Physical Sciences Facility (PSF) Project scope exceeded the cost cap for the project. As a result, PNNL performed an Options Analysis (CRL-RPT-PM-001, Rev. 0) in October 2006 to identify options for reducing the TPC while still providing for the necessary research and development capabilities. Out of this analysis, the U.S. Department of Energy (DOE) approved a modified PSF Project scope: CD-1R. This option included the proposal for retaining four facilities in the 300 Area of the Hanford Site, including the 325 Building, a DOE hazard category (HC)-2 nuclear facility.

The 325 Building was first placed into operation in 1954 and has operated continuously since then. In support of CD-1R and the retention of Building 325, life extension requirements were developed and incorporated into the PSF Project baseline. The requirements included the activities associated with the transition of the DOE approved Documented Safety Analysis (DSA) from the Office of Environmental Management (EM) to the Office of Science (SC). Over several months, discussions with SC staff and advisors led to the development of logic or process flow diagrams that would guide the DOE decision making process in support of the DSA approval authority transition.

Several assessments were highlighted as necessary to support the decision:

- comparison of the existing 325 Building safety basis against current DOE requirements and guidance
- natural phenomena hazards (NPH) assessment update
- scoping hazards analysis
- phase I safety system assessment (SSA)
- Defense Nuclear Facility Safety Board (DNFSB) 2004-2 evaluation the 325 Building ventilation system
- major modification evaluation of upgrades.

In addition, the PSF Project has developed a Safety Design Strategy (SDS) for the 325 Building extended mission (CRL-PLAN-ESH-001, Rev. 0). The purpose of the SDS is to show how the PSF Project is ensuring that safety basis considerations are integrated with the identification and design development of facility upgrades. The SDS considered all relevant information found in the supporting assessments and as outlined in the logic diagrams provided by SC.

Recognizing that the Pacific Northwest National Laboratory's (PNNL's) risk tolerance for the PSF Project may be different than the DOE's, the project was directed to perform a risk assessment that is specifically focused on the 325 Building extended-mission and potential risks to SC acceptance of operations. This report provides the requested risk assessment.

2.0 Life Extension

To assure that the 325 Building can safely perform its proposed extended mission, the PSF Project, in addition to initial facility and upgrade determination, has developed an SDS for the 325 Building extended mission (CRL-PLAN-ESH-001, Rev. 1). The purpose of the SDS is to define the strategy for ensuring that safety basis considerations are integrated with the identification and design development of facility upgrades. Activities that are in alignment with the SDS and have been initiated in support of CD-2 include

- facility modification and upgrade determination
- NPH assessment update
- DOE safety basis new requirements review
- scoping hazards analysis
- phase I SSA
- DNFSB 2004-2 evaluation the 325 Building ventilation system

The conclusions and recommendations from these activities provide information that supports defining: 1) proposed additional facility upgrades needed to meet DOE requirements and 2) the strategy for development of the updated DSA for the 325 Building extended mission. Project planning will be based on an acceptable level of risk tolerance (i.e., the risk to workers and the public from operating the 325 Building for the extended mission). Table 1 summarizes worker and public risk identified in these activities for the near term (i.e., until the upgraded DSA is implemented) and for the extended mission. The discussions in the following subsections support the summary table.

2.1 Natural Phenomena Hazards Assessment Update

Purpose and scope: DOE O 420.1B, *Facility Safety*, requires that NPH assessments of DOE facilities be reviewed every 10 years. Since the most recent seismic and wind evaluation of the 325 Building was completed in 1992, work was contracted by PNNL to perform an updated seismic and wind evaluation of the 325 Building in support of the 325 Building extended mission (CRL-INC-07-0014, *Seismic and Wind Evaluation of Building 325 at Pacific Northwest National Laboratory*).

Results and conclusions: The NPH assessment shows that the 325 Building is non-compliant with current DOE seismic criteria primarily because it lacks sufficient lateral load-resisting systems and detailing required by current seismic criteria. The assessment identified specific structural components and connections that need to be strengthened to bring the 325 Building into compliance with DOE PC-2 seismic criteria (DOE-STD-1020-2002) for the PC-2 design-basis earthquake (DBE).

The PSF Project has developed 30 percent or higher design media for each identified modification and has developed an estimated cost to design and implement each modification (total estimated cost of $2.6 million). The estimated cost of these modifications has been incorporated into the PSF Project cost and schedule baseline. Implementation of these modifications is anticipated to bring the 325 Building into compliance with current DOE PC-2 seismic criteria for the PC-2 DBE.

Table 1. Worker and Public Risk from Extended Mission Modifications

				Public and Worker Risk	
Activity	**Proposed Path Forward**	**Identified Physical Modifications**	**Identified Safety Basis Upgrades**	**Near-Term Risk (until new Safety Basis is implemented)**	**Extended Mission Risk (next 20 years)**
NPH assessment update	Implement upgrades to bring the 325 Building into compliance with current PC-2 criteria for DBE	Reinforcements to 325 Building non-compliant structural components and connections.	Minimal	LOW The proposed seismic modifications provide no reduction in public and on-site worker risk, but would provide a reduction in facility worker risk because the facility will be able to withstand a slightly more severe earthquake.	LOW Current PC-2 criteria for seismic events will be met.
Review of new DOE safety basis requirements	Meet requirement for specific administrative control (SAC) and functional classification strategy by the upgraded safety basis documents (DSA and technical safety requirements [TSR])	None	An upgraded safety basis that meets current standards and expectations will be developed.	LOW The current safety basis documentation does not meet current expectations for a HC-2 facility with a long-term mission. However, the dose consequences from most of the events identified in the Scoping Hazards Analysis are low for the onsite worker or the public. The extended mission DSA will update treatment of worker hazards and related controls.	LOW The upgraded safety basis will meet current regulatory expectations.
Scoping Hazards Analysis	Designate hot cells and glove boxes as SS Design Features (DFs); identify Administrative Controls (ACs) and Safety Management Programs (SMPs) specifically for protection of the facility worker	None	Designation of DFs, ACs and SMPs to specifically protect the facility worker.	LOW The Scoping Hazards Analysis did not identify the need for new safety significant (SS) structures, systems and components (SSC), ACs, or SMPs that are not already identified in the existing DSA. However, to meet current safety basis expectations, hot cells and glove boxes are identified as SS DFs. This change represents an improvement in risk for the facility worker.	LOW The upgraded safety basis will meet current regulatory expectations.
Phase I SSA	Phase II assessment not needed	None	None	LOW All active safety systems are currently operable, well-maintained, and in very good condition.	LOW The ageing of safety systems or structures will be compensated for by maintenance and replacement programs.

Table 1. (contd)

				Public and Worker Risk	
Activity	**Proposed Path Forward**	**Identified Physical Modifications**	**Identified Safety Basis Upgrades**	**Near-Term Risk (until new Safety Basis is implemented)**	**Extended Mission Risk (next 20 years)**
325 Building Ventilation System Assessment (DNFSB 2004-2)	No ventilation system performance gaps identified.	None	None	LOW The ventilation system is not a significant part of the safety basis strategy.	LOW The ventilation system is not a significant part of the safety basis strategy.
Facility Modification and Upgrade Determination	The project baseline modifications.	See Section 2.6	None	LOW The project baseline modifications are not related to maintaining or improving nuclear safety risk to the workers or public.	Low The project baseline modifications are not related to maintaining or improving nuclear safety risk to the workers or public.

Worker and public risk: The dose consequence from unlikely and extremely unlikely seismic events represents the highest risk to onsite worker and public, but still does not challenge the Evaluation Guidelines. The current safety basis strategy (current DSA) and proposed strategy (Scoping Hazards Analysis) do not depend on any system to operate during a seismic event, therefore there is no PC-3 designation for safety related system. The proposed seismic modifications, therefore, provide no reduction in public and on-site worker risk.

In the 1992 NPH evaluation, the 325 Building was shown to meet the seismic design criteria at that time (Uniform Building Code, 1992). The current DOE seismic design criteria for the PC-2 DBE are for a slightly bigger earthquake (6.2 vs. 5.8 on the Richter scale or 0.17 g vs. 0.1 g ground acceleration). Both earthquakes have an annual frequency of about 10^{-4}. While the proposed seismic modifications are necessary to bring the 325 Building into compliance with current DOE seismic design criteria, the modifications will also provide a slight reduction in the risk to the facility worker since the post-modified facility will be able to withstand a slightly larger DBE.

2.2 Review of New DOE Safety Basis Requirements

Purpose and scope: The 325 Building DSA and associated TSRs were first issued in 2003. The DSA is updated at least annually to address new identified hazards and unreviewed safety question (USQ) evaluations. The current revision of the DSA was issued in September 2006 (PNNL-DSA-RPL). A major update to the DSA will be performed to support the 325 Building extended mission. In preparation for this update, PNNL has performed a review of DOE directives and standards issued since 2002 to identify safety basis requirements that need to be incorporated to bring the updated DSA into compliance with these new requirements. The results of this review are documented in *DOE Requirements Review for the Extended-Mission 325 Building Safety Basis* (CRL-TECH-ESH-003, Revision 0).

Results and conclusions: Based on this review, the assessment concluded that

- SACs will need to be implemented for the 325 Building extended-mission safety basis. Current TSRs identified for consideration to be converted to SACs were
  - Radioactive Material Limits, which is currently a set of Limiting Conditions of Operations (LCOs)
  - Nuclear Criticality Safety Program, which is currently an administrative control
- the 325 Building extended-mission safety basis should use the functional classification approach per DOE-STD-3009-94 CN3 and the facility worker functional classification approach per DOE-STD-1189-2006 Draft. This proposed classification approach has been implemented in the 325 Building Life Extension Safety Design Strategy, CRL-PLAN-ESH-001, Revision 1 (Draft). The controls for all events identified in a 325 Building extended-mission hazards analysis would be developed based on this new criteria. The Scoping Hazards Assessment (see Section 2.3) used this classification criteria.

The assessment further concluded

- The need for additional safety class or safety significant SSCs or ACs are not anticipated from an analysis of an aircraft crash into the 325 Building per DOE-STD-3014 or from performing criticality safety evaluations consistent with the requirements of DOE-STD-3007-2007.

- There is no compelling reason to change from the seismic criteria in DOE-STD-1020-2002 to American National Standards Institute (ANSI) seismic design criteria as recommended in DOE-STD-1189-2006 Draft. The NPH assessment discussed in Section 2.1 addresses proposed facility upgrades necessary to meet DOE-STD-1020-2002 criteria for PC-2 structures.
- The fire protection requirements from DOE O 420.1B are already included in Battelle's contract with DOE to operate PNNL and the 325 Building fire engineers are currently in the process of preparing a Record of Decision against these new requirements.
- The additional safety basis documentation required by DOE O 413.3A are not applicable to the 325 Building extended-mission project unless the facility upgrades must be performed as a "major modification" as defined in 10 CFR 830.3. The definition of major modification and its applicability to the 325 Building extended-mission project is addressed in Section 4.
- Changes to DOE-STD-1104-96 CN3 from CN2 provide no new safety analysis requirements relevant to the 325 Building extended-mission project.

Worker and public risk: A review of changes to DOE safety basis requirements identified no new requirements that would reduce public and on-site worker risk. The implementation of SACs and the revised functional classification strategy will provide some improvement in worker safety. Any improvement in worker safety, however, is minimal since the facility worker is adequately protected by SMPs. Section 3 provides additional discussion of existing SMPs. Section 2.3 provides additional discussion on the expected impact of the revised functional classification strategy.

2.3 Scoping Hazards Analysis

Purpose and scope: The purpose of the Scoping Hazards Analysis (CRL-TECH-ESH-004, Rev. 0) was to provide the PSF Project with information about potentially needed safety upgrades in support of CD-2 on extended mission for 325 Building. The assessment was accomplished by 1) performing a scoping hazards analysis of the 325 Building extended mission, 2) allocating controls to hazardous conditions determined to require controls and 3) summarizing the safety SSCs determined to be needed to reduce risk to workers and the public.

Results and conclusions: The Scoping Hazards Analysis did not identify any SS SSCs, ACs, or SMPs not already credited in the existing 325 Building DSA. Two passive features were identified to be designated as new SS DFs were credited: hot cell structures and glove box structures. These DFs reduce the consequences to the facility worker from spills, fires or explosions in the structures. Formerly identifying these structures as DFs is a minor administrative change to the existing safety basis for 325 Building and is expected to cost no more than $50,000 to $100,000.

Worker and public risk: The dose consequences from unlikely and extremely unlikely seismic events represent the highest risk to the onsite worker and public. The new DFs provide no reduction in the risk to these receptors. While formerly identifying hot cells and glove boxes as SS DFs will provide some improvement in worker safety, these DFs essentially already exist for the purpose of protecting the facility worker because they are under configuration management and performance monitoring even though they are not currently identified as DFs in the TSRs.

During the in-depth safety basis development process additional needed nuclear safety controls may be identified. However, significant changes are not anticipated and the controls are likely to be related to refinements and realignments of SMP elements to protect the facility worker. The dose consequences from most of the events identified in the Scoping Hazards Analysis are well below the evaluation guidelines for the onsite worker or the public so no additional SS SSCs are expected to be identified during development of the upgraded DSA.

2.4 Phase I Safety System Assessment

Purpose and scope: The purpose of the *325 Building Safety System Assessment*, CRL-INC-07-0007 (Rev. 0), was to assess the operational readiness of 325 Building safety systems for an extended 20-year operational life. This assessment is an element of the 325 Building Life Extension Safety Design Strategy (CRL-PLAN-ESH-001, Rev. 1) and is implemented consistent with DNFSB Recommendation 2000-2, *Configuration Management, Vital Safety Systems*.

The operational readiness of each of the 325 Building safety systems was assessed using the review approach and criteria developed by DOE for Phase I assessments as provided in "Criteria, Review, and Approach Document (CRAD) for the Assessment of Operational Readiness of Vital Safety Systems."

Results and conclusions: The 325 Building Phase I SSA found that each of the assessed safety systems satisfied the CRAD assessment criteria, specifically

- The safety systems were found to be operational, well-maintained, and processes are in place for maintaining continued operational readiness.
- The programmatic processes in place provide a sound basis for continued operational readiness.

The assessment did not identify any findings, and only a few minor or favorable observations were reported. Based on these results, the assessment concluded that there was no basis for recommending a follow-on Phase II assessment.

Worker and public risk: No change to the public, on-site worker or facility worker risk. All active safety systems are currently operable, well-maintained and in very good condition. The ageing of safety systems and structures will be monitored, and systems will be replaced as necessary within the facility's existing preventive and corrective maintenance programs.

2.5 325 Building Ventilation System Assessment

Purpose and scope: In response to a request from the DOE Pacific Northwest Site Office (PNSO), the Capability Replacement Laboratory Projects performed an evaluation of the 325 Building ventilation system in accordance with the DOE Implementation Plan for the Defense Nuclear Facilities Safety Board Recommendation 2004-2 per guidance in Deliverables 8.5.4 and 8.7, *Ventilation System Evaluation Guidance for Safety-Related and Non-Safety-Related Systems*. The Radioactive Exhaust Ventilation System (REVS) is a part of the ventilation system that has been cited in the current DSA as providing defense-in-depth (DID) for certain accidents. In accordance with the DOE 2004-2 evaluation guidance (*Deliverables 8.5.4 and 8.7 of Implementation Plan for Defense Nuclear Facilities Safety Board Recommendation 2004-2*), the ventilation system in general and the REVS in particular were evaluated using applicable DID and SS criteria defined in Table 5-1 of the evaluation guidance (CRL-INC-07-0024, *Hanford Site Building 325 DNFSB Recommendation 2004-2 Ventilation System Evaluation*).

Results and conclusions: A functional classification of DID was re-determined based on the predicted radiological consequences to receptors from postulated events as evaluated in the DSA and supporting analyses for the facility per the evaluation guide. Furthermore, this assessment did not identify any gaps involving a discrepancy between the safety basis requirements and the facility design. Accordingly, no cost/benefit evaluation was performed for modifications as none would be necessary to address gaps. Based on this evaluation, the assessment team recommended no further action.

Worker and public risk: No change to the public, on-site worker or facility worker risk. No part of the ventilation system is credited, currently or as part of the proposed facility upgrade, for reducing the consequences to onsite or offsite receptors (mitigation) due to a postulated accident identified in the DSA. The ventilation system does not contribute significantly to the nuclear safety basis strategy. It is cited only as DID for four accident cases. The safety basis strategy depends strongly on LCOs for radioactive material quantities and other ACs, along with the Fire Suppression System.

On the other hand, the 325 ventilation system does meet performance criteria important to facility worker radiation protection such as zone control (e.g., differential pressure between zones and the atmosphere is maintained).

2.6 Facility Modification and Upgrade Determination

Purpose and scope: A discussion of proposed 325 Building extended mission upgrades are presented in CRL-RPT-PM-001, *Capability Replacement Laboratory, Revised Options Analysis*, October 2006. More detail about these upgrades is presented as scope-of-work definitions in CRL-TECH-ENG-003, Rev. 1, March 2007. The proposed upgrades consist of the following:

- procure and install modular hot cells:
  - Mechanical Properties Test Cell
  - Metallography Cell
- upgrade the 325 Building heating, ventilation and air conditioning (HVAC) system:
  - remove 16 fume hoods (and blank-off 13-15)
  - install six glove boxes (two designs)
  - install four standard modular hot cells
  - install shielded (modular) storage
  - upgrade the stack monitoring system
- replace the Static Pressure Control System (supply fan flow controllers)
- construct a covered exterior stairwell access to the 325 Building 2nd floor (reduces the need for facility workers and visitors to traverse a radiological buffer area to access 2nd floor offices)
- replace the Personnel Contamination Monitoring System
- repair the roof of the Main Building and Annexes A, B and C and replace the roof of the Filter Building

- make other life extension upgrades (replace heating and cooling coils, air conditioning unit, supply fan, backup air compressor, and exhaust ductwork).

Results and conclusions: As part of the revised PSF Project options analysis, engineers at PNNL reviewed the condition of the 325 Building (as well as the three other buildings proposed for retention) to determine the investment needed to eliminate backlog maintenance and repair to ready the facility for the extended mission. The conclusion was that no predictable investments over those initially identified by the facility were needed (Tab 12, Comparison Operating Costs, of CRL-RPT-PM-001). This is further supported, with respect to safety systems, by the Phase I SSA (Section 2.4) which concluded that active safety systems are currently operable, well-maintained and in very good condition and that ageing issues will be compensated for by normal maintenance and replacement programs.

The PSF Project has developed 30 percent or higher design media for each identified upgrade and has developed an estimated cost to design and implement each modification (total estimated cost of $23.4 million). The estimated cost of these modifications has been incorporated into the PSF Project cost and schedule baseline. Implementation of these modifications is anticipated to extend the mission of the 325 Building by 20 years.

Worker and public risk: None of the facility upgrades or improvements are driven by nuclear safety concerns. The most significant modification is the removal of fume hoods and addition of hot cells and glove boxes. The primary purpose of this change is to replace capability that will be lost when other facilities are deactivated and also to increase ventilation capacity. This motivation is not related to nuclear safety or protecting workers and the public from dose consequences from potential accidents. The Scoping Hazards Analysis (Section 2.3) assessed these facility changes but did not identify any changes needed in control strategy based on these differences. The Phase I SSA (Section 2.4) concludes that ageing of systems or structures will be compensated for by normal maintenance and replacement programs.

2.7 Risk from 325 Building Extended 20-Year Operation

The proposed modifications identified in Table 1 are the result of a comprehensive effort by the PSF Project to ensure that the 325 Building can be operated safely for an additional 20 years and that it can provide the research capabilities needed for the extended mission. The identified modifications accomplish the following:

- Maintain five mission-critical capabilities: 1) Shielded Operations, 2) Radiation Detection, 3) Material Science and Technology, 4) Chemistry and Processing, and 5) Subsurface Science. The Mechanical Properties Test Cell and the Metallography Cell, in particular, are included in the 325 Building extended-mission as a replacement capability for the former Shielded Operations Facility originally planned to be incorporated into the newly constructed PSF.
- Provide for the facility and system upgrades necessary to operate the facility safely for an additional 20 years. All upgrades identified as necessary to the extended 20-year operating life are included in the PSF Project scope.

- Provide for the facility and system upgrades necessary to ensure the 325 Building meets current DOE standards and DOE-directed initiatives for an HC-2 nuclear facility. The seismic upgrades, in particular, were identified in the updated NPH Assessment as necessary to meet current DOE seismic standards for PC-2 structures.
- Provide for the DSA upgrades necessary to ensure the 325 Building meets current federal requirements and DOE standards for nuclear safety basis development and implementation. Upgrade of the DSA and associated TSRs is included in the PSF Project scope.

All of the proposed modifications identified in Table 1 have been included in the PSF Project work scope. This fact, and the comprehensive and varied scope of the assessments, provides a high degree of confidence that the identified facility, system and DSA modifications and upgrades will provide for safe operation of the 325 Building for the extended 20-year mission and that there are no necessary major modifications or upgrades that have gone undetected.

3.0 DSA IMPACTS

3.1 Current DSA Risk and Safety Management Program Controls

This section discusses the control strategy and risk presented in the current DSA and TSR, and implications for the transition to the upgraded DSA.

The specific hazard controls selected in the current 325 Building DSA and identified in the 325 Building TSR are consistent with approach the *Nuclear Safety Risk Ranking and Control Selection Guidelines* issued by the current EM regulatory authority, the DOE Richland Operations Office (RL) in letter 03-ABD-0047. Under this guidance specific evaluation guidelines and risk matrix classifications to be used in support of control decisions are provided for the offsite public and the hypothetical onsite worker located 100 meters from the facility.

With respect to facility worker protection the DOE-RL guidance states:

> For facility worker protection, significant hazardous events are evaluated for appropriate controls in accordance with DOE-STD-3009 Change Notice 2. The activity-specific controls (e.g., personal protective equipment and hot work permit) should be developed as part of a work control process, not as a specific part of the Safety Basis per 10 CFR 830. The actual implementation of work control process should be reviewed as part of the annual ISMS verification. For those events identified in the hazard analysis that require a control that is not contained in an SMP, a discrete administrative control should be established.

For evaluation of normal operations the DOE-RL guidance states:

> The protection of the public and workers during normal operations is governed by 10 CFR 835, Occupational Radiation Protection; unintended (incidental) releases of sufficiently high frequency, considered a part of normal operations, would also be governed by this regulation. Programmatic commitment to implement 10 CFR 835 is made in the DSA.

Per DOE-STD-3009-94 (CN-3):

> Considerations should be based on engineering judgment of possible effects and the potential added value of safety-significant SSC designation.
>
> This Standard maintains that all SSCs with a safety function do not require classification as equipment requiring detailed description in the DSA (i.e., safety-class SSCs and safety-significant SSCs). As noted in the Introduction, this is one of the principle reasons for the emphasis on programmatic commitments.

The current 325 Building DSA is based on a graded approach to DOE-STD-3009-94. The details of this graded approach and discussion of how each section of DOE-STD-3009-94 is satisfied is provided in Appendix A of the DSA. The current DSA has an abbreviated table of contents compared to DOE-STD-3009-94, and does not include separate chapters on SMPs. The TSRs defer to the SMPs for application and management of SSCs for facility worker safety. This graded approach to DOE-STD-3009-94 was deemed acceptable by the DOE approval authority for a facility with limited remaining operational life. With the decision to extend the life of the 325 Building, the DSA should be upgraded to provide the full format and content of DOE-STD-3009-94 and corresponding changes to the TSR document may also be necessary.

Chapter 5 of the DSA provides basic information on the facility management structure and safety management programs. Chapter 6 of the DSA provides hazards and control analyses for facility workers, on-site (100 meter) workers, and the maximum offsite individual (public), and identifies accident scenarios to be carried forward into the accident analysis. Chapter 7 of the DSA provides quantitative accident analysis of the offsite public and onsite worker risk. Facility worker risks are not addressed in Chapter 7.

The controls identified in Chapter 6 and credited in Chapter 7 with reducing the risk to the on-site worker and the public include

- inventory limits (protects inventory assumptions used in the accident analyses)
- fire suppression system (reduces probability of larger fires).

These controls are identified as discrete LCOs in the TSR. In addition, programmatic controls associated with radioactive material evaluation, radiation protection, fire protection, nuclear criticality safety and worker safety programs are identified as ACs in the TSR.

The current DSA risk profile for the maximum offsite dose (i.e., the public) is shown in Figure 1.

The 2007 annual update of the DSA and TSR has been submitted to RL for approval. This update includes a reduction in the facility and area tritium LCO limits. The risk profiles for the public and the on-site worker based on the reduced tritium limits are shown in Figures 2 and 3.

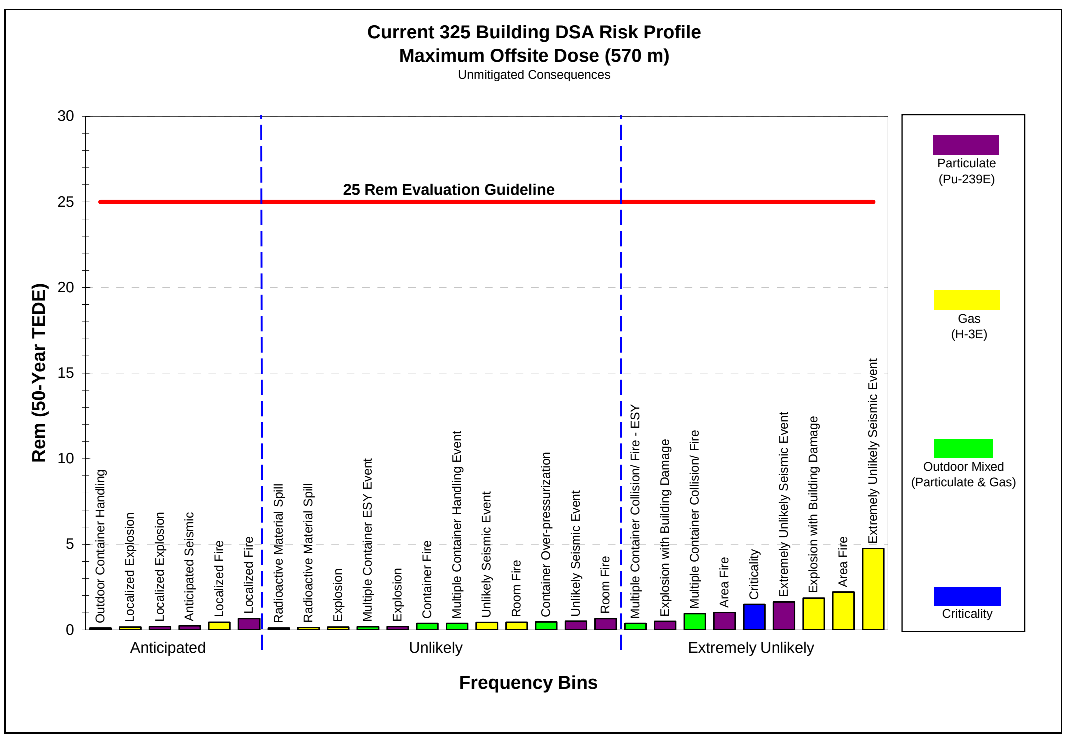

Figure 1. DSA Risk Profile – Offsite Public Dose

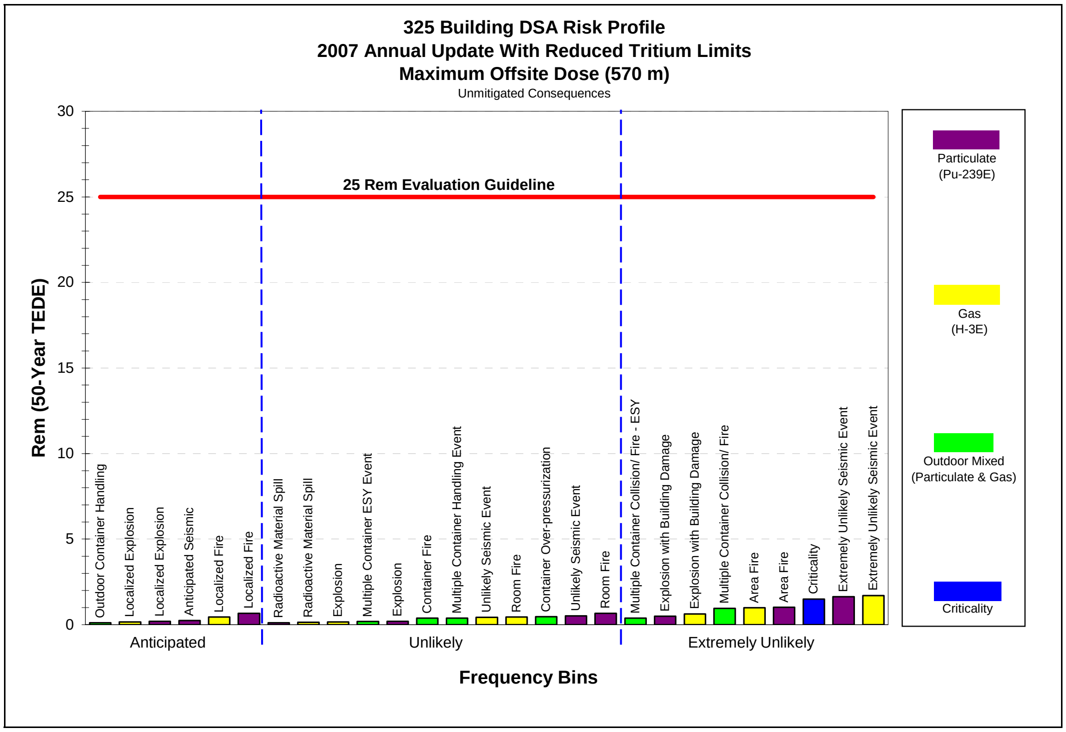

Figure 2. Revised DSA Risk Profile – Offsite Public Dose

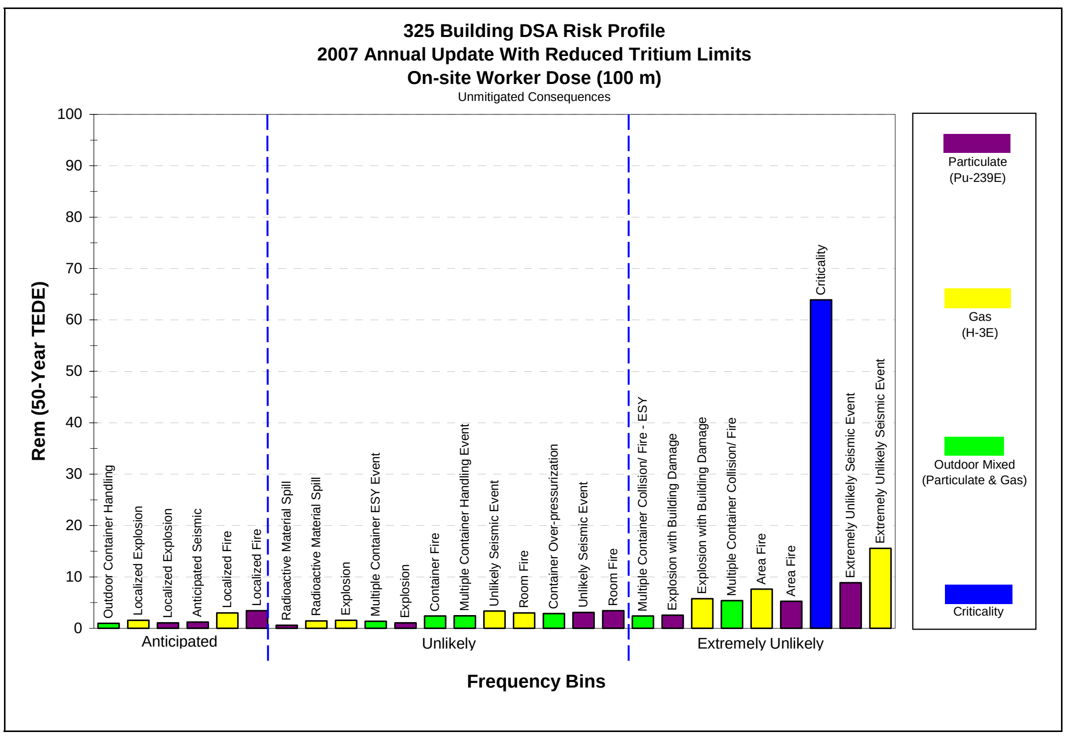

Figure 3. Revised DSA Risk Profile – Onsite Worker Dose

As shown in these figures, no unmitigated accidents analyzed in the current DSA exceed 5 rem maximum offsite dose or challenge the 25 rem evaluation guideline. With implementation of the 2007 DSA, all unmitigated analyzed accidents will result in less than 2 rem maximum offsite dose.

Under the 2007 DSA, the maximum on-site (100 meter) dose will be less than 20 rem, with exception of the criticality accident. The criticality accident analyzed in the DSA is conservatively based on NRC methodology for a fissile solution event that assumes 48 criticality bursts over an 8-hour period, terminated after evaporation of 100 liters of solution. This scenario is not based on and does not reflect the risk of actual 325 Building operations. High concentration fissile solutions in the 325 Building are only handled in laboratory quantities, typically less than 0.1 liter (100 milliliters). There are no activities or processes in the 325 Building that involve substantial (multi-liter or multi-kilogram) quantities of high concentration fissile solutions or fissile material, and criticality safety limits preclude handling or combining such quantities. A criticality accident in the 325 Building is considered an extremely low probability event, but cannot be shown to be implausible.

Work on radioactive materials in the 325 Building involves activities and operations that are typically characterized by use of small quantities of hazardous or radioactive materials for individual experimental or analytical procedures. The research and development activities may be conducted in hot cells, glove boxes, fume hoods and on laboratory bench tops, depending on the radioactive or hazardous nature of the work. As discussed in DSA Section 5.3, *Safety Management Program Hazard Controls*, SMPs are identified as hazard controls in the hazards analysis described in DSA Chapter 6, particularly for facility worker safety. The DSA determined that there are no unique facility worker protection features that are not provided by the SMPs. Therefore, facility worker protection controls are not explicitly identified as discrete TSRs beyond the SMP level. Accordingly, these SMPs and the essential characteristics of these programs are included in 325 Building TSRs. The TSRs defer to the SMPs for application and management of SSCs for facility worker safety. This approach to identification of facility worker controls in the TSR is based on the guidance provided in DOE-STD-3009-94 and RL letter 03-ABD-0047.

In addition to standard industrial hazards (e.g., fall potential, rotating machinery, energized electrical equipment), the primary hazards to facility workers in the 325 Building are associated with handling laboratory quantities of dispersible radioactive material and direct radiation exposure from activated materials. Protection for facility workers from laboratory chemicals is provided through the Worker Safety SMP, which includes limits on storage and use of chemicals and activity reviews by safety and health representatives as necessary. The primary SMP that provides facility worker protection from radiation hazards is the PNNL Radiation Protection Program. This program is essential to controlling radiological materials and personnel radiation exposures in the 325 Building. The Radiation Protection Program fully implements the requirements of 10 CFR 835, *Occupational Radiation Protection*, and has been reviewed and approved by DOE.

The Radiation Protection Program has established requirements for determining the appropriate type of engineered confinement systems to be used for radiological work, when monitoring and alarm systems must be deployed to provide facility worker protection, and requirements for periodic surveys and assessments to verify that program requirements are being met. Specific program requirements include the following:

- An administrative dose limit of 500 millirem/year for radiation workers. This limit necessitates that activities involving radioactive materials with substantial dose potential must be handled inside glove boxes or hot cells.
- Work involving uncontained dispersible radionuclides with high radiotoxicity (e.g., Pu-238, Pu-239, Am-241) in quantities that have the potential for ≥ 100 millirem in an acute exposure is required to be performed inside glove boxes. Work involving potentially hazardous quantities of dispersible radioactive materials that do not exceed the glove box thresholds is required to be performed inside other forms of engineered containment (e.g., fume hoods, glove bags).
- Real-time air monitoring (e.g., use of continuous air monitors [CAMs]) is required as necessary to detect and provide warning of airborne radioactivity concentrations that warrant immediate action to terminate inhalation of airborne radioactive material. The PNNL radiation protection program has administratively established a threshold of ≥ 40 derived air concentration-hours (DAC-h) (approximately equivalent to 100 millirem) for use of real time air monitoring. Occupied work areas that require real-time monitoring include but are not limited to
  - each glove box that is used for high radiotoxic materials (americium, plutonium, californium, and curium isotopes, as well as a number of other high specific activity alpha-emitters)
  - each storage room that is used to store potentially dispersible high radiotoxic materials
  - areas near the doorway to hot cell air locks used for access purposes
  - areas near cell transfer mechanisms or ports.

Program procedures provide guidance and requirements for placing CAMs in service, daily CAM inspections, weekly CAM response checks, CAM sample exchange and establishing CAM alarm set points.

- Area dose rate monitoring and contamination surveys are required to be performed weekly in routinely occupied areas. In addition, dose rates in areas around hot cells that are not surveyed weekly are surveyed monthly. Unique activities involving the potential for significant exposures or uptakes may required elevated monitoring and survey requirements, as determined by the program. These monitoring and survey activities periodically validate the effectiveness of hot cell and glove box confinement features, as well as other radiation protection program features.
- A hierarchy of preferred controls is specified, with engineered controls preferred over administrative controls or personnel protective equipment. This requirement reinforces reliance on hot cells and glove boxes over other controls.
- Confinement ventilation in the form of cascading air flow (flow from non-contaminated or low contaminated areas towards higher contamination areas) with relative negative pressure in the confinement structures (e.g., glove boxes, hot cells) is required in order to perform radiological work. Routine work activities are required to be terminated and access to the room is restricted if radiological confinement ventilation is interrupted. Confinement ventilation is not limited to use of the facility ventilation system. Special portable high efficiency particulate air (HEPA) filtered ventilation units may be required by the Radiation Protection Program for specific activities that do not involve substantial radiation hazards.

As discussed in DSA Section 6.3.2.2, glove boxes and hot cells are part of the radioactive material controls provided by the Radiation Protection Program, which is specifically identified in the TSRs as an AC. Although glove boxes and hot cells are part of the Radiation Protection Program, they are not specifically identified in the TSRs as discrete controls. Glove boxes and hot cells are fixed structures that are part of the facility and under facility configuration management processes and procedures. Other radiation protection features such as CAMs may be portable equipment that is not physically part of the facility. Structural modifications to facility SSCs are controlled under the existing engineering procedures and requirements. These procedures include design development requirements that include incorporation of applicable codes and standards, technical reviews of changes, document control and configuration management, and monitoring/tracking of change implementation. All changes to facility SSCs, including hot cells and glove boxes, are reviewed under the 325 Building Unreviewed Safety Question process.

Other SMPs identified in the TSRs include

- **Radioactive Material Evaluation Program.** Tracks and evaluates inventories for LCO compliance, mandates periodic surveillance of facility holdup, establishes a program to control qualified forms and containers.
- **Fire Protection Program.** Controls storage and use of combustible and flammable materials and ignition sources, maintains and tests the fire alarm and fire suppression systems, reviews facility modifications. In addition to the AC for the Fire Protection Program, an operable fire suppression system is specifically required by an LCO.
- **Nuclear Criticality Safety Program.** Applies the double contingency principle to operations involving fissionable materials, provides a criticality alarm system in accordance with ANSI/ANS-8.3, limits storage of fissionable material to preclude criticality without reliance on safe storage configurations (geometry).
- **Worker Safety Program.** Uses the integrated PNNL Environment, Safety, Health, and Quality management system to apply Integrated Safety Management System (ISMS) principles in analyzing and controlling work.

3.2 New Design Features

As part of development of the Scoping Hazards Analysis documented in CRL-TECH-ESH-004, glove boxes and hot cells were identified for potential designation as facility DFs the TSRs. The proposed redesignation from features contained within a programmatic AC to formal identification in the TSR as discrete DFs is an administrative reclassification and change in description of existing controls. This redesignation does not involve changes in the actual safety function or performance for these passive barriers as relied on by the DSA and, therefore, does not constitute identification of new TSR controls. The existing requirements, programs and processes contained in the Radiation Protection Program combined with existing maintenance and configuration management processes in the 325 Building are sufficient to assure effective performance and control of these features until the upgraded DSA is approved by SC and implemented by PNNL.

3.3 Specific Administrative Controls

As part of the DOE safety basis requirements review documented in CRL-TECH-ESH-003, SACs, as described in DOE-STD-1186-2004, were identified as candidates for incorporation into the 325 Building extended-mission safety basis. Two current TSRs were identified for consideration to be converted to SACs:

- Radioactive Material Limits, which is currently a set of LCOs
- Nuclear Criticality Safety Program, which is currently an administrative control.

The LCO format of the current Radioactive Material Limits is specifically identified in DOE-STD-1186-2004 as one of two acceptable SAC formats. The TSR changes required to convert the material limit LCOs to SACs would be limited to redesignating the LCOs as SACs. However, implementing this change would require extensive revisions to all procedures and systems that refer to the existing LCOs, and personnel responsible would have to be trained on these changes. Changing from LCOs to SACs would also introduce the potential for confusion or possible noncompliance with procedures or TSRs. Therefore, converting the Radioactive Material Limits from LCOs to SACs provides little or no material benefit. Continued operation under the existing LCOs until the upgraded DSA and TSRs are implemented presents essentially no risk relative to SACs.

The Nuclear Criticality Safety Program includes a number of programmatic requirements and features that will be considered for SACs during development of the upgraded DSA and TSR. Self-assessments and periodic criticality alarm system testing and maintenance have not identified any significant deficiencies with the current Nuclear Criticality Safety Program as invoked by the existing programmatic AC for the Nuclear Criticality Safety Program. Continued operation under the existing programmatic AC until the upgraded DSA and TSRs are implemented presents very low risk.

3.4 Revised Safety System Functional Classification Criteria

As part of the DOE safety basis requirements review documented in CRL-TECH-ESH-003, the 325 Building extended-mission safety basis needs to use the functional classification approach per DOE-STD-3009-94 CN3 and the facility worker functional classification approach per DOE-STD-1189-2006 (Draft). This proposed classification approach has been implemented in the *325 Building Life Extension Safety Design Strategy*, CRL-PLAN-ESH-001, Revision 1. The controls for all events identified in a 325 Building extended-mission hazards analysis would be developed based on this new criteria. As a result of using this revised classification criteria, the Scoping Hazards Assessment identified just one change in the safety control strategy from that in the current 325 Building DSA: the designation of hot cell structures and glove box structures as Design Features. The impact of this change on the current DSA is discussed in Section 3.2.

3.5 Reclassification of the Radioactive Exhaust Ventilation System

The suitability of the REVS for providing an SS DSA-credited accident mitigation capability was previously assessed in 2004 (2003 DSA, Revision 2), and the REVS was downgraded in the DSA to provide a non-credited DID function under the Radiation Protection Program. Although the REVS itself is a robust, well-maintained, reliable system, the confinement ventilation boundary formed by the facility exterior walls is essentially metal-skinned. Energetic events such as significant fires, explosions and major seismic events have the potential to breach the facility exterior, thereby degrading or defeating confinement ventilation capability. In addition, the filtration function provided by the REVS is not capable of mitigating releases of radioactive gases (primarily tritium). For the subset of particulate-based accidents that did not potentially challenge the confinement envelope provided by the facility walls, the unmitigated accident consequences were less than 1 rem to the public and less than 5 rem to the on-site worker. Based on the control selection guidelines and guidance provided by RL, it was determined that dose mitigation of the 325 Building accidents was not required beyond inventory limits and RL accepted the risk of 325 Building accidents without filtration.

As currently written, the DSA identifies the REVS as SS because it potentially provides an additional layer of protection to a limited subset of potential accidents involving radioactive particulates and, therefore, is considered DID. Under the current safety equipment classification structure used at PNNL, equipment formally identified as DID in the DSA is considered part of the SS category based on the definition of SS contained in 10 CFR 830. In the Scoping Hazard Analysis the REVS was determined to be DID because it can only provide potential mitigation of a limited subset of analyzed accidents, and the unmitigated consequences of those accidents do not require mitigation. As part of the upgraded DSA development activity, consideration will be given to establishing DID as a separate equipment classification category below SS. Under that classification structure the REVS would be classified as DID only. Due to facility structure limitations and the types of radioactive materials that may be present in the 325 Building, the REVS does not provide substantial mitigation capability for significant accidents and is not considered suitable to be classified as an SS system.

3.6 Risk of Remaining Under the Current Safety Basis

Until an upgraded Safety Basis (DSA, TSR, and SER) for the 325 Building is approved by SC and implemented by PNNL, the 325 Building is required to operate in accordance with its existing Safety Basis approved by RL. As previously discussed, the format and content of the DSA and TSR need to be changed to support an extended mission for the 325 Building. The safety basis change control process (Administrative Procedure RPL-SA-006, *Safety Basis Development and Change Implementation Process*) already in place accommodates planned DSA and TSR modifications, including those proposed to support the 325 Building extended mission. The activity to develop the upgraded DSA will include review of hazard analyses and control selection decisions and possible identification of new controls. Should hazards or conditions be identified that indicate the potential for an inadequacy in the existing DSA or TSR, they will be evaluated in the USQ process.

As discussed previously, the 2007 DSA reduces the bounding unmitigated consequences for the maximum offsite dose to less than 2 rem. Other than criticality the maximum unmitigated on-site worker (100 meter) dose is less than 20 rem, but that consequence is based on a total facility tritium equivalent (H-3E) inventory of 900,000 Ci. Actual facility radioactive gas inventories in the 325 Building will not exceed 200,000 Ci H-3E based on current air permit limits. The maximum on-site dose for bounding accidents involving particulates represented by Pu-239 dose equivalent (Pu-239E) Ci is less than 10 rem based on a total Pu-239E inventory of 1,500 Ci. The current 325 Building inventory of dispersible radioactive particulate material is less than 300 Ci Pu-239E, and is not expected to increase substantially in the foreseeable future. Given the nature of the conservative assumptions and analysis applied in evaluating offsite public and on-site worker risks and controls, the probability of identifying significant new risks to these receptors under the current safety basis is considered low. Additional reductions in TSR inventory limits were considered, including reductions in the Pu-329E limits for radioactive particulates. It was determined that further limit reductions had the potential to introduce programmatic impacts on the 325 Building mission.

Under the current safety basis, facility worker hazards will continue to be addressed by the SMPs. The Radiation Protection Program provides the primary control for nonstandard industrial hazards to 325 Building facility workers. This program requires periodic surveys, surveillances, and self-assessments to assure that radiation protection requirements are adequately met. This program will continue to implement the requirements of 10 CFR 835. For the level of radiation exposure hazards encountered in the 325 Building, this program is adequate to protect facility workers until the upgraded DSA is implemented.

The Fire Protection Program maintains the fire alarm and suppression system. These systems were specifically evaluated in the 325 Building Safety System Assessment, which determined that the current condition, maintenance, and testing of these systems was adequate. There were not significant deficiencies identified in these systems. The existing Fire Protection Program requirements and facility procedures are adequate to maintain these systems until the upgraded DSA is implemented.

The Nuclear Criticality Safety Program maintains the 325 Building Criticality Alarm System (CAS). The CAS associated criticality safety controls meets the requirements of ANSI/ANS-8.3. This system was specifically evaluated in the 325 Building SSA, which determined that the current condition, maintenance and testing of this system was adequate. The existing Nuclear Criticality Safety Program requirements and facility procedures are adequate to maintain this system until the upgraded DSA is implemented.

4.0 Major Modification Determination

There are no specific DOE-approved criteria for determining when a facility modification should be considered a "major modification." The definition of a major modification is provided by 10 CFR 830 (the Rule), Section 830.3:

> *Major modification* means a modification to a DOE nuclear facility that is completed on or after April 9, 2001 that substantially changes the existing safety basis for the facility.

The scope of proposed 325 Building modifications are encompassed by the current 325 Building safety basis documentation. There are no new facility hazards, energy sources or hazardous material inventories associated with the facility upgrades, there is no change to a TSR required by hazard or accident analysis[1], and nothing in the project scope indicates an increased probability or consequence from an analyzed accident. Based on these considerations, the set of proposed facility modifications do not represent a substantial change to the safety basis and therefore should not be considered a major modification.

Additionally, the draft standard DOE-STD-1189, *Integration of Safety into the Design Process*, provides criteria for determining the need for a preliminary documented safety analysis (PDSA) to support a facility modification. The development of a PDSA, and its approval by DOE, are required by 10 CFR 830 for any major modification. Per Section 830.206,

> …the contractor responsible for a hazard category 1, 2, or 3 new DOE nuclear facility or a major modification to a hazard category 1, 2, or 3 DOE nuclear facility must:
>
> (a) Prepare a preliminary documented safety analysis for the facility, and
>
> (b) Obtain DOE approval of:
>
> (1) The nuclear safety design criteria to be used in preparing the preliminary documented safety analysis unless the contractor uses the design criteria in DOE Order 420.1A, *Facility Safety*; and
>
> (2) The preliminary documented safety analysis before the contractor can procure materials or components or begin construction…

The criteria of the standard are designed to determine the need for a PDSA, and thus discern whether a facility modification meets the definition for a major modification.

The explicit requirement for a PDSA is to document the nuclear safety design criteria to be used for the facility modification and to obtain DOE approval prior to procurement or construction. As provided by Appendix A of the Rule,

> A preliminary documented safety analysis can ensure that substantial costs and time are not wasted in constructing a nuclear facility that will not be acceptable to DOE…As a general matter, DOE does not expect preliminary documented safety analyses to be needed for activities that do

[1] The Scoping Hazards Analysis anticipates additional safety significant DFs; however, this is a result of the methodology for hazard control selection, and not a result of new hazardous or accident conditions.

not involve significant construction such as environmental restoration activities, decontamination and decommissioning activities, specific nuclear explosive operations, or transition surveillance and maintenance activities.

4.1 Scope of Proposed Facility Modifications

The description of planned 325 Building extended-mission modifications is provided in CRL-TECH-ENG-003 (Rev. 1), *Building 325 Life Extension Projects Functional Design Criteria,* and in CRL-RPT-PM-001, *Capability Replacement Laboratory, Revised Options Analysis*. These modifications are summarized in Table 2 and are included in the PSF Project scope.

Other modifications may be considered and recommended as a result of activities described in CRL-PLAN-ESH-001 (Rev. 1), *325 Building Life Extension Safety Design Strategy*. These activities are intended to evaluate 1) the condition of the current facility to withstand severe NPHs (e.g., seismic, wind), 2) the operational readiness of active safety systems, 3) the adequacy of the radioactive exhaust ventilation system and 4) the scope of hazards and potential accident conditions for the extended life mission. The results and conclusions of each of these assessments are summarized in Section 2 of this report.

The updated NPH assessment (CRL-INC-07-0014, *Seismic and Wind Evaluation of Building 325 at Pacific Northwest National Laboratory*) is the only evaluation that has identified additional physical facility modifications. These modifications are summarized in Table 2 and are necessary for the 325 Building to meet seismic design criteria for PC-2 structures. The PSF Project scope includes these proposed modifications. Neither CRL-INC-07-0007, *325 Building Safety System Assessment,* or CRL-INC-07-0024, *Hanford Site Building 325 DNFSB Recommendation 2004-2 Ventilation System Evaluation,* identified any additional modifications.

As provided by CRL-PLAN-ESH-001, the existing safety basis documentation for the 325 Building will be upgraded to meet the graded approach for HC-2 DSA for facilities with a long-term mission. In advance of this effort, CRL-TECH-ESH-004, *Scoping Hazards Analysis and Control Allocation for the 325 Building Extended Mission*, forecasts the safety SSCs and TSRs for the upgraded documentation based on current DOE guidance and expectations.

The current 325 Building DSA addresses hot cells and glove boxes through the Radiation Protection Program and its associated TSR AC (see Section 3). Under the upgraded safety basis, these are anticipated by the Scoping Hazards Analysis to be re-designated as discrete safety significant DFs. This redesignation from features within a programmatic AC to discrete DFs is an administrative reclassification that does not reflect a change in the actual safety function or performance required for these passive barriers by the Scoping Hazards Analysis or the 325 Building DSA. In addition, the radioactive exhaust ventilation system will no longer be an SS system as the Scoping Hazards Analysis and review of the DSA accident analysis determined that it is only capable of providing DID protection to a limited set of accidents, and provides no protection for release of radioactive gases (primarily tritium). Therefore, it was determined that the radioactive exhaust ventilation system should not be designated beyond a DID system. The set of controls from the Scoping Hazards Analysis is provided in Table 3.

Table 2. Proposed 325 Building Modifications

<table>
<tr><th>Source Document</th><th colspan="4">Scope of Proposed Facility Modifications</th></tr>
<tr><td>CRL-TECH-ENG-003, Rev. 1, Building 325 Life Extension Project Functional Design Criteria and CRL-RPT-PM-001, Capability Replacement Laboratory, Revised Options Analysis</td><td colspan="4">• Procure and install modular hot cells:
– Mechanical Properties Test Cell
– Metallography Cell
• Upgrade the 325 Building HVAC system:
– Remove 16 fume hoods (and blank-off 13-15)
– Install 6 glove boxes (2 designs)
– Install 4 Standard Modular Hot Cells
– Install Shielded (Modular) Storage
– Upgrade the Stack Monitoring System
• Replace the Static Pressure Control System (supply fan flow controllers)
• Construct a covered exterior stairwell access to the 325 Building 2nd floor
• Replace the Personnel Contamination Monitoring System
• Repair the roof of the Main Building and Annexes A, B, and C and replace the roof of the Filter Building
• Make other Life Extension Upgrades (replace heating/cooling coils, air conditioning unit, supply fan, backup air compressor, and exhaust ductwork)</td></tr>
<tr><td rowspan="20">CRL-INC-07-0014, Seismic and Wind Evaluation of Building 325 at Pacific Northwest National Laboratory</td><th>Area</th><th>Structural Component or Connection</th><th>Estimated Quantity</th><th>Possible Strengthening</th></tr>
<tr><td>Original Building</td><td>Column G-6, second floor to low roof, axial force and moment</td><td>1</td><td>Add brace providing direct load path from low roof to second floor.</td></tr>
<tr><td>Original Building</td><td>Vertical brace on Column Line K between Column Lines 5 and 6, axial compression</td><td>1</td><td>Add cover plates to existing brace or reduce unbraced length.</td></tr>
<tr><td>Original Building</td><td>Vertical braces on Column Line A between Column Lines 5 and 6, axial tension</td><td>2</td><td>Add cover plates to existing brace or reduce unbraced length.</td></tr>
<tr><td>Original Building</td><td>Vertical braces on Column Line 1 between Column Lines H and J, axial tension</td><td>2</td><td>Add braces</td></tr>
<tr><td>Original Building</td><td>Connections for vertical braces on Column Line 1 between Column Lines H and J, weld shear</td><td>8</td><td>Add weld</td></tr>
<tr><td>Original Building</td><td>Roof brace connections, weld shear</td><td>4</td><td>Add weld</td></tr>
<tr><td>Original Building</td><td>Base plates for first story columns, bending</td><td>7</td><td>Add gusset plates</td></tr>
<tr><td>Original Building</td><td>Connections from columns to roof beams, weld shear</td><td>16</td><td>Add weld</td></tr>
<tr><td>Original Building</td><td>Connections to concrete pilasters, pilaster tie tension</td><td>4</td><td>Add anchorage</td></tr>
<tr><td>Original Building</td><td>First floor diaphragm collectors to interior basement shear walls, north-south beam axial force and moment</td><td>8</td><td>Add cover plates to beams, add weld to beam connections.</td></tr>
<tr><td>Original Building</td><td>Second floor diaphragm collectors, beam connection weld shear</td><td>4</td><td>Add weld</td></tr>
<tr><td>Original Building</td><td>Basement walls, out-of-plane moment</td><td></td><td>Add steel strongbacks or carbon fiber strips.</td></tr>
<tr><td>A Annex</td><td>Connection for girt on Column Line 10 between Column Lines K and M, axial compression, bolt shear</td><td>2</td><td>Weld connection</td></tr>
<tr><td>A Annex</td><td>Anchor bolts for Columns M-10 and N-10, tension and shear</td><td>2</td><td>Add anchorage</td></tr>
<tr><td>A Annex</td><td>Expansion anchors for beam connections at original building wall, tension</td><td></td><td>Add anchorage, strengthen beams and beam connections, weld beams to precast panels, strengthen panel to wall connections.</td></tr>
<tr><td>A Annex</td><td>Girt on Column Line 10 between Column Lines M and N, weak-axis bending</td><td>1</td><td>Add cover plate</td></tr>
<tr><td>B Annex</td><td>Post-installed anchors connecting basement walls to the original building wall, tension</td><td></td><td>Add anchorage</td></tr>
<tr><td>B Annex</td><td>Post-installed anchors connecting the first floor to the original building wall, tension and shear</td><td></td><td>Add anchorage</td></tr>
<tr><td>B Annex</td><td>Post-installed anchors for first floor diaphragm ledger angle at Column Line 8, tension and shear</td><td></td><td>Add anchorage</td></tr>
</table>

Table 3. Proposed Credited SSCs for the 325 Building Extended Mission

SSC	Safety Function	Functional Requirements	Comment
SS: Fire Suppression System **DID: Fire Detection and Alarm**	Reduce probability of fire propagation.	The capacity to prevent a local fire from spreading	The Fire Suppression System is always credited in conjunction with the Fire Protection System AC. The Fire Protection System AC provides controls on ignition sources, fire detection and alarm and other functions.
SS: Qualified Containers	Reduce consequences to the facility worker, off site worker and public from fires spills, and explosions.	Structural container integrity sufficient to resist breaching from impacts, mishandling events, explosions and the heat generated in a fire.	
SS DF: High-Level Radiochemistry Facility (HLRF) Hot Cell Structure	Reduce consequences to the facility worker from a hot cell spill, fire, or explosion	HLRF hot cell structural integrity sufficient to contain most of the energy from a hot cell explosion or deflagration, and reduce dispersal of material inside the building from spill or fire.	
SS DF: Shielded Analytical Laboratory (SAL) Hot Cell Structure and Tank TK-1 Vent	Reduce consequences to the facility worker from a hot cell spill, fire, or explosion Reduce probability of significant dose consequences or serious injury to the facility worker from a tank deflagration.	SAL hot cell structural integrity sufficient to contain most of the energy from a hot cell explosion or deflagration, and reduce dispersal of material inside the building from spill or fire Drain tank (TK-1) from SAL hot cell vented sufficient to prevent the accumulation of hydrogen from radiolysis	
SS DF: Modular (Mini) Hot Cell Structure	Reduce consequences to the facility worker from a hot cell spill, fire, or explosion	Modular hot cell structural integrity sufficient to contain most of the energy from a hot cell explosion or deflagration, and reduce dispersal of material inside the building from spill or fire	
SS DF: Glove Box Structure	Reduce consequences to the facility worker from a hot cell spill, fire, or explosion.	Glove box structural integrity sufficient to contain most of the energy from a hot cell explosion or deflagration, and reduce dispersal of material inside the building from spill or fire	
DID: Radioactive Exhaust Ventilation System (REVS)	Reduce the dose consequence from facility events to the off site worker and public.	Direct the radioactive release from a facility-wide event through the final stage exhaust HEPA filters.	Includes dedicated support systems such as Faulted Electrical Power.
DID: Criticality Alarms	Reduce consequences to the facility workers from a criticality.		The Nuclear Criticality Safety Program Control requires double contingency, criticality alarms and limits on fissionable material.

Further enhancing confidence that other safety SSCs will not be required by the upgraded DSA is a reduction in the inventory limits for tritium to be implemented by the 2007 annual update of the 325 Building DSA and TSR. This reduction is as follows:

Current Tritium Inventory Limit	Revised Tritium Inventory Limit
3E+6 Ci (Building)	9E+5 Ci (Building)
6E+5 Ci (Area)	1.8E+5 Ci (Area)

This change represents a 67 percenet tritium limit reduction and results in a reduced risk profile for the facility. The pre-reduction and post-reduction risk profiles for the offsite public are shown graphically in Figures 1 and 2. The worst case public dose does not approach evaluation guidelines (25 rem).

4.2 Evaluation of Major Modification

Table 4 applies the set of proposed facility modifications to the Major Modification criteria of DOE-STD-1189 (draft) with consideration of new safety SSC designation of hot cells and glove boxes by the Scoping Hazards Analysis. The conclusion, based on the guidance in DOE-STD-1189 (draft) and the example PDSA determinations provided in Appendix J of the draft standard, is that the comprehensive set of planned facility modifications does not require the support of a PDSA and thus does not represent a Major Modification.

4.3 Facility Change Control

The facility change control processes (Administrative Procedures ADM-CM-058, *Facility Design Manual*, and ADM-CM-55, *Facilities and Operations Project Management Manual*) already in place accommodate planned facility modifications, including those proposed to support the 325 Building extended mission. The engineering change process includes the development and control of formal modification packages and system drawings. The USQ process is used to determine if the proposed change or the discovered information is within the DOE-approved safety basis prior to implementing the change. If a positive USQ determination results, then DOE review and approval of the proposed change must be obtained prior to its implementation.

DOE involvement in decisions for 325 Building extended mission activities is not limited by use of existing facility processes to manage proposed changes. The PSF Project is obligated to consider DOE input on all aspects of the project and address comments and input, as evidenced by the involvement of DOE in the participation and review of assessments, the Scoping Hazards Analysis, and proposed upgrades. The opportunity by DOE to review and comment on documentation and design media related to the project is enhanced by the instituted formal lines of communication within the PSF project.

Table 4. Major Modification Determination for Scope of Planned 325 Building Modifications

Evaluation Criteria	Clarifying Detail and Examples	Discussion
1. Add a new building or facility with a material inventory ≥ HC 3 limits or increase the HC of an existing facility?	A new building may be a structure within an existing facility segment. That structure may or may not have direct process ties to the remainder of the segment / process. The requirements of DOE-STD-1027-92 shall be used in evaluating HC impacts.	The planned and recommended modifications do not include the addition of a new building or facility or increase the HC of the existing facility. The tritium inventory is being reduced by 70% which decreases the overall risk profile of 325 Building. The seismic upgrades do not involve a new building or facility and are not associated with material inventory. This criterion is not tripped.
2. Change the footprint of an existing HC 1, 2 or 3 facility with the potential to adversely impact any SC or SS safety function or associated SSC?	A change in the footprint of an existing facility requires the identification and evaluation of any potential adverse impacts on SC or SS safety functions or associated SSC (e.g., structural qualification, evacuation egress path, fire suppression spray pattern) or safety analysis assumptions. Changes that may involve adverse impacts require careful attention to maintaining adherence to applicable engineering standards and nuclear safety design criteria.	The planned and recommended modifications do not change the footprint of the existing 325 Building and do not affect the safety function of existing safety SSC (i.e., fire alarm and suppression system, radioactive exhaust ventilation system, criticality alarm system, the faulted electrical power system, and the safety significant portion of the compressed air system). The scoping HA estimates that the safety functions of most of these existing safety SSC will not increase in importance in the upgraded DSA and, in some cases, become less important. The seismic upgrades do not impact the facility footprint and do not impact the safety function of safety SSC. This criterion is not tripped.
3. Change an existing process or add a new process resulting in the need for a safety basis change requiring DOE approval?	A change to an existing process may negatively affect the efficacy of an approved set of safety controls for a given event or accident. Likewise potential safety concerns associated with a new process may not be adequately addressed by the existing approved control sets. In this case, it is assumed that the existing analyses addressed the hazards associated with the new or revised process, but the specified control set(s) may no longer be valid. The evaluation of any new hazards introduced by the revised or new process should be addressed via Criterion 6	The planned / recommended modifications do not add a new process or change an existing process. The addition of new hot cells and glove boxes maintain the existing operational capability of the facility by replacing a large number of fume hoods (up to 16) which place a greater demand on the building ventilation system. The selection of safety SSC and hazard controls are not affected by the modification since the facility already contains hot cells and glove boxes, and their safety-related function and performance criteria are not expected to change. Because the scope of activities is maintained and the existing set of safety SSC and hazard controls are adequate to support the modifications planned or recommended, there is no additional process or change to the existing process that involves a safety basis change requiring DOE approval. The seismic upgrades do not represent a new process or change an existing process. This criterion is not tripped.

Table 4. (contd)

Evaluation Criteria	Clarifying Detail and Examples	Discussion
4. Use new technology or government furnished equipment (GFE) not currently in use or not previously formally reviewed or approved by DOE for the affected facility?	This assessment should include consideration of the impact that the use of new technology (including technology scale-up issues) or GFE may have on the ability to specify the applicable nuclear safety design criteria with a high degree of certainty in the early stages of the project. Additionally, refer to GFE discussion in Section 9.3. GFE may have a technical baseline that is not directly and fully supportive of the project functional and performance requirements. An example would be employing a new technology for removal of certain nuclides from a waste stream.	The planned and recommended modifications do not use new technology or GFE. Hot cells and glove boxes presently exist in the facility; the addition of new modular hot cells and new glove boxes do not represent a new technology nor one that is not currently in use. The seismic upgrades do not represent new technology or GFE. This criterion is not tripped.
5. Create the need for new or revised Safety SSCs?	Consideration should be given to the relative complexity of the controls and the ease with which the controls can be implemented. The use of a complicated multi-channel Safety Class seismically qualified instrumented system to provide multiple interlock and alarm functions would typically pose a higher risk to the project than the use of an SS passive design feature. The degree of design and regulatory uncertainty should be addressed for this criterion for the development, review, and approval of new or revised safety analysis and attendant controls (e.g., presence of multiple regulatory and technical agencies on a single project).	The planned and recommended modifications include the addition of up to 6 new modular hot cells and 6 glove boxes. The current safety basis does not identify the facility hot cells or glove boxes as discrete safety SSC (they are features of the Radiation Protection Program) however the Scoping Hazards Analysis forecasts that the upgraded DSA will specifically identify hot cells and glove boxes as safety significant DFs for worker safety. This redesignation does not reflect a change in the actual safety function or performance required for these passive barriers beyond that currently assumed in the 325 Building DSA and provided under the existing Radiation Protection Program. The modification itself does not create the need for new safety SSC but these are to be new safety SSC as a result of the upgraded DSA. On the other hand, the new safety SSCs are passive design features that will meet seismic design criteria for PC-2 structures. The existence of the structure itself provides the required safety function; no active systems are needed to maintain the confinement boundary. In addition, the new hot cells and glove boxes will be connected to the exhaust ventilation system upstream of the safety significant radioactive exhaust ventilation system. The hot cells and glove boxes will include heat detectors and mechanical connections for a fire extinguisher. These detectors and connections are similar to the fire detection and suppression capability for the existing hot cells and glove boxes and are separate from the safety significant fire alarm and suppression system installed in the facility. The seismic upgrades do not create the need for new or revised safety SSCs.

Table 4. (contd)

Evaluation Criteria	Clarifying Detail and Examples	Discussion
		While this criterion could be tripped due to the anticipated designation of existing and planned hot cell and glove box structures as passive SS DFs for facility worker safety in the upgraded DSA and TSR, the criterion should not be tripped since these are relatively simple structures that are currently relied on for worker safety, do not involve complex active features, and present low regulatory uncertainty.
6. Involve a hazard not previously evaluated in the DSA?	Hazards can include the introduction of an accident or failure mode of a different type from that previously analyzed in addition to radiological or toxicological hazards. The need to address a new hazard early in the design process may lead to some degree of uncertainty related to the proper specification of applicable nuclear safety design criteria. In such cases, this uncertainty should be addressed within this evaluation.	The Scoping Hazards Analysis did not identify new hazards or potential accidents that are not evaluated by the current DSA. The anticipated addition of hot cells and glove boxes as worker safety DFs is not a result of new identified hazards, but a recognition that the upgraded DSA for the extended mission must meet current expectations for the safety basis. The seismic upgrades do not represent a new hazard, but do reduce the facility vulnerability to the existing seismic hazard. This criterion is not tripped.
Conclusion: One of the six criteria (Criterion 5) could be tripped due to the anticipated designation of hot cell and glove box structures as SS DFs in the upgraded DSA. However, since these structures are relatively simple structures that are currently relied on for worker safety, do not involve complex active features, and present low regulatory uncertainty, Criterion 5 should not be tripped. Furthermore, of the scope of the 325 Building modifications currently planned for the PSF Project, only the addition of the hot cells and glove boxes have any relation to the facility safety basis. These represent no new processes, involve no new hazards or new technology, and are anticipated to be passive SS DFs in the upgraded safety basis. Therefore, this scope does not require a PDSA and thus does not constitute a major modification.		

5.0 Safety Design Strategy Path Forward

The *325 Building Life Extension Safety Design Strategy* (CRL-PLAN-ESH-001, Rev. 1) has been updated based on the results of the activities and assessments discussed in this report. The update reflects the results of assessment activities except for DNFSB 2004-2 finalization, the logic for major modification determination, and the rebaselining of transfer of safety basis regulatory authority to SC.

The strategy for upgrading the safety basis documents (DSA and TSRs) is based on the need for the following:

- a DSA to support long-term operation of the 325 Building in lieu of the current document graded to a HC-2 facility near its end of operational life
- incorporation of explicitly identified facility worker safety elements, such as SS DF, TSR AC, and Safety Management Programs
- Meeting current DOE requirements, applicable DOE and SC guidance, and facility management expectations for a contemporary DSA and TSR.

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6.0 Cost–Benefit Analysis

A formal cost–benefit analysis was not performed for this assessment primarily because:

- All of the proposed facility modifications identified in Section 2 of this report are being implemented by the PSF Project.
- All of the DSA analyzed accidents have less than a 2 rem maximum offsite dose, which does not approach the evaluation guideline of 25 rem. All of the DSA analyzed accidents have an onsite worker dose well below the evaluation guideline of 100 rem. Facility workers are well protected by existing/planned TSRs and SMPs.
- The system assessments described in Section 2 identified no programmatic need to upgrade or replace the existing safety SSCs.

This section does, however, identify potential upgrade options for DOE to consider.

6.1 Risk Reduction Opportunities

To provide for the safe operation of the 325 Building for its extended 20-year mission, PNNL is implementing the following risk reduction opportunities:

1. The 2007 annual update of the DSA and TSR has been submitted to DOE for review and approval. This update included reductions in area and facility LCO limits for tritium. These limit reductions result in a decrease in postulated offsite dose consequences of approximately 65 percent for the bounding seismic event and 55 percent for the bounding fire event. This results in all DSA analyzed accidents having less than 2 rem maximum offsite dose. These inventory reductions do not impact current or projected programmatic mission requirements for the 325 Building. Further inventory limit reductions would have potential programmatic impacts.
2. PNNL plans to perform all 325 Building seismic upgrades identified in the updated NPH assessment within the scope of the PSF Project. This will improve the seismic response capability of the facility such that it will meet current code requirements for a new facility. This improvement in seismic performance does not translate quantitative risk reduction under the current DSA analysis methodology because it is not sufficient to shift the design basis seismic event to a lower frequency bin or affect the response of the bounding (beyond design basis) seismic event that assumes substantial facility damage. However, these upgrades will assure the facility will perform as or better than analyzed in the DSA and qualitatively provide an improved risk posture for the 325 Building with respect to all seismic events.
3. Characterization and removal of legacy radioactive materials and holdup are continuing. A legacy Pu-238 heat source containing a significant quantity of material was removed from the facility in 2006. Activities are ongoing to provide characterization of conditions in the legacy tank vault located in the East Storage Yard in preparation for eventual remediation activities.
4. The 325 Building management structure and work authorization process are currently undergoing changes to improve rigor in conduct of operations and provide better oversight of 325 Building activities.

5. The PSF Project has performed several assessments of 325 Building safety systems, including a confinement ventilation system assessment per DNFSB Recommendation 2004-2. These assessments have not identified significant discrepancies or weakness in the 325 Building safety systems as currently credited in the DSA.

6.2 Risk Acceptance Options

The list of proposed 325 Building modifications described in this report is believed to be comprehensive, representing necessary research capabilities, extension of facility operating life, and current DOE standards and requirements. No additional cost-beneficial modifications have been identified that have not been incorporated into the PSF Project scope.

However, options do exist for further reducing the nuclear safety risk of continued operation of the 325 Building for an additional 20 years. Identified options for consideration are provided in Table 5. The identified options do not include safety system upgrades to be performed within the existing facility routine and preventive maintenance program. The PNNL Facilities and Operations (F&O) organization has certified this program will be fully funded through the annual operating budgets for the extended 20-year operating life of the facility (CRL-RPT-PM-001). Maintenance includes routine, recurring and non-recurring, and large non-recurring maintenance of structures, systems and components.

The first option in Table 5 is actually a cost reduction (savings) opportunity. The PSF Project plans to bring the 325 Building into compliance with DOE PC-2 seismic criteria for a newly constructed facility. Since the 325 Building is an existing facility, DOE requirements allow for a DBE that is somewhat less intense than that for a newly constructed facility. As noted in the table, the resulting savings would be small as would be the increased risk to the facility worker.

The second option, upgrading the ventilation system to provide PC-3 confinement ventilation capability, has very high cost for little risk reduction. The third and final option, expanding coverage provided by the existing criticality alarm system, has a moderately high cost with little risk reduction. The existing system has limited reserve expansion capacity that may be needed to support operation of the new hot cells. The cost estimate reflects an upper bound estimate to expand the system beyond this reserve capacity.

6.3 Cost–Benefit Conclusions

All proposed facility, system and DSA modifications have been incorporated into the PSF Project scope. No additional cost-beneficial modifications have been identified.

Table 5. 325 Building Upgrade Options[1]

Option	Estimated Cost ($)	Benefit (qualitative)	Disposition
Perform only sufficient structural component and connection strengthening needed to bring the 325 Building into compliance with current DOE PC-2 seismic criteria for an existing facility (the PSF Project baseline is to upgrade the 325 Building to be compliant with PC-2 seismic criteria for a new facility).	~$0.5M savings	Small increased risk to the facility worker since the facility will be able to withstand a slightly less severe DBE.	The incremental cost of upgrading the facility from PC-2 DBE-Existing to PC-2 DBE criteria is small relative to the perceived improvement in risk reduction and showing compliance with seismic criteria for a new facility.
Upgrade the facility and ventilation system to provide PC-3 confinement ventilation capability.	> $50M[2]	Reduction in calculated on-site and offsite accident consequences for some events.	Risk to onsite workers and public as calculated in the 325 Building DSA does not warrant PC-3 level of protection. Such an upgrade would not mitigate releases of radioactive gases (e.g., tritium).
Expand coverage provided by the existing criticality alarm system.	< $2M[2]	Provides additional areas authorized for fissionable material operations. (Note, this does not reduce the risk of a criticality accident.)	The limited expansion capability of the existing criticality alarm system needs to be reserved in case it is needed to support existing coverage after the additional hot cells are installed in the facility. There are no programmatic or operational needs that require expansion of the existing criticality alarm system coverage.

[1]The identified options do not include safety system upgrades to be performed within the existing facility routine and preventive maintenance program. The PNNL F&O organization has certified this program will be fully funded through the annual operating budgets for the extended 20-year operating life of the facility (CRL-RPT-PM-001). Maintenance includes routine, recurring and non-recurring, and large non-recurring maintenance of structures, systems, and components.

[2]Cost estimate is a rough-order-of-magnitude estimate based on engineering judgment.

7.0 Overall Risk Posture

An assessment of the overall risk posture for the 325 Building is provided in this section. Within the context of this discussion, risk has the following definitions:

- Nuclear safety risk – the risk to the public, onsite worker, and offsite worker from operation of the 325 Building both in the short term (under the existing DSA) and the longer term (under the upgraded DSA).
- Project risk – the risk to PNNL and DOE of completing the PSF Project on schedule and within budget given identified uncertainties in project scope, regulatory requirements, technical complexity, material and labor costs, etc.
- Composite risk – In addition to nuclear safety and project risk, this includes facility operational risks after the modifications are implemented, programmatic risks (risks to research and development projects conducted within the facility), and perceived safety risk to the public from continued operation of the facility.

7.1 Nuclear Safety Risk

The safety risk posture for the facility for both short term operation until the current safety basis documents are implemented, and long-term operation under the upgraded safety basis, is considered Low.

The assessments described in this report address facility SSCs:

- **Structure:** The facility structure was evaluated against the most significant natural phenomena hazards, seismic and wind loads associated with a PC-2 structure. The upgrades to meet PC-2 for a new facility are included in the project baseline.
- **Systems:** The facility systems were evaluated by the 325 Building Safety System Assessment and the 2004-2 Active Confinement Ventilation evaluation. These assessments resulted in finding that systems are well-maintained and that no upgrades are necessary for the facility safety systems.
- **Components:** The scoping hazards analysis anticipates that glove boxes and hot cells, existing as well as those planned for incorporation, will be designated as SS DFs for worker safety under the upgraded safety basis. The existing hot cells and glove boxes are managed under the Radiation Protection Program, a TSR Administrative Control.

The existing safety management programs, such as the Radiation Protection Program, have effectively managed the SSCs that they support as discussed in Section 3.0. Based on the assessments performed that demonstrate the overall health of the facility and its processes, and considering the relatively low risk profile of the facility, the risk of short-term operation under the existing safety basis is considered Low.

Based on the results of the Scoping Hazards Analysis, significant changes to the upgraded safety basis are the result of programmatic requirements and expectations for a new DSA and TSR rather than any deficiencies in the existing safety basis. These details are presented in Section 2.0. The long-term risk remains Low because the upgraded safety basis will incorporate these SC expectations as well as contemporary DOE requirements and guidance, strengthening the identification of safety basis elements that support worker safety. These include the safety significant glove boxes and hot cells and development of SMP descriptions. Further reducing the risk profile for both the short and long-term is a 67 percent reduction in the facility and area inventory limits for tritium.

7.2 Project Risk

Per the Capability Replacement Laboratory *Risk Management Plan* (RMP) (CRL-PLAN-PM-002, Rev. 1), an updated project risk analysis is performed at least quarterly and the detailed results documented in a project risk analysis report. The most recent update of the project risk analysis was performed in early April 2007 in support of a pre-CD-2 DOE Lehman Review of the PSF Project. This project risk analysis was updated for this report by including additional project risks identified as a result of the assessments discussed in this report (see Table 6). The results and conclusions from this risk analysis are essentially unchanged from those provided to the Lehman Review committee. A summary of the results are as follows:

- The 80 percent confidence level for the project completion date (CD-4B) is December 22, 2010. The conclusion of this analysis, therefore, is that the 5 months of schedule contingency accounted for in the PSF Project is adequate, or it provides greater than 80 percent confidence, in meeting the late start date for project closeout of 28 Feb. 2011.
- The 80 percent confidence level for the project TPC amount is $217 million. The conclusion of this analysis, therefore, is that the $38.4 million of to-go contingency for the PSF Project is adequate, or provides greater than 80 percent confidence, in meeting the TPC cap of $224 million.
- A determination that the planned 325 Building modifications are a Major Modification per 10 CFR 830 would delay the schedule for development and approval of the upgraded DSA by 3 to 12 months to support preparation of a PDSA. An additional impact would be the need to perform an Operational Readiness Review (ORR), which would extend the schedule for the planned Readiness Assessment by an additional 3-12 months.

7.3 Composite Risk

A composite risk assessment was performed that qualitatively evaluated how other types of risk, other than project risk, are impacted by the conclusions and recommendations of the various SDS assessments and the planned path-forward (or planned modifications) for the project. Other types of risk impacts evaluated included public or off-site dose impacts, worker safety impacts, extended facility life impacts, 325 Building conduct of operations impacts, programmatic impacts on the PNNL research and development (R&D) mission, and perceived risk by the public. The evaluation was performed using expert judgment. The results for each of these risk types are presented in Table 7. While not universal, the impacts tend to be positive. The exception is in conduct-of-operations impacts and programmatic impacts where additional safety controls result in additional procedures and associated training.

Also included in Table 7 is the estimated cost impact and project risk impact of implementing the recommended modifications. All of the identified cost impacts have been incorporated in the PSF Project cost and schedule baseline. Furthermore, the project risk analysis, which included all of the identified project risks, concluded that the available PSF Project cost and schedule contingency is adequate to meet project performance objectives.

Table 6. Identified Project Risks

Source of Risk	Project Risk	Project Impact	Likeli-hood	Schedule Impact	Cost Impact	Mitigation Actions	Residual Risk
Major Modification Determination for 325 Building Upgrades (Appendix A)	Recommended 325 Building upgrades are determined to be a 10 CFR 830 Major Modification by DOE.	Delays the completion of the DSA by one year to allow preparation of a PDSA. The schedule for the Readiness Assessment (RA) or ORR is extended to support DOE participation. Maintain the existing DOE-EM approved DSA for an additional year.	11 –25%	DSA: 3 –12 months ORR: 3 –12 months	\$500K – \$1,000K	– Prepare Risk Assessment Report – Perform Phase I Safety System Assessment – Perform NPH Assessment – Perform scoping hazards assessment – Perform DOE requirements review (Completed) – Perform DNFSB 2004-2 Assessment – Obtain authorization from DOE for Early Procurement Authority	Likelihood (1 –10%) Schedule Impact (3 – 9 months) Cost Impact (Unchanged)
Scoping Hazards Analysis (Appendix C)	New SS SSC or AC identified during development of the updated safety basis.	Low impact is change to DSA only (e.g., new AC). High impact is to upgrade a system (e.g., REVS, Fire Protection System) to SS.	1 –10%	3 –12 months	\$100K – \$2,000K	Scoping Hazards Analysis identified no new SS SSCs or ACs. No further action.	Unchanged
	New DOE requirements require material inventory in qualified containers be included in the building inventory for accident analyses.	Low impact is change to DSA only. High impact is to upgrade a system to be SS.	11 –25%	3 –12 months	\$100K – \$2,000K	Remove qualified containers and associated inventory from 325 Building and dispose/transfer to another facility (programmatic impact).	No residual risk.
DOE Safety Requirements Review (Appendix E)	Development of the updated DSA identifies the need for SACs that are not currently LCOs.	Cost impact to prepare 1 or 2 non-LCO SACs and assess design implications. The schedule impact would be minimal as the work would be performed within existing schedule.	26 –75%	0 –2 weeks	\$100K – 250K	Propose an LCO format to DOE for concurrence.	Unchanged

Table 6. (contd)

Source of Risk	Project Risk	Project Impact	Likeli-hood	Schedule Impact	Cost Impact	Mitigation Actions	Residual Risk
Natural Phenomena Hazards Assessment Update (Appendix B)	Recommended seismic upgrades not adequate to meet DOE-STD-1020-2002 criteria for PC-2 DBE-Existing.	New facility upgrades identified during design development.	11 – 25%	3 –12 months	\$500K – \$1,000K	Baseline includes funds for seismic upgrades identified in NPH assessment to meet PC-2 DBE. No further action.	Unchanged
	DOE requires upgraded facility to meet seismic criteria more stringent than DOE-STD-1020-2002.	Additional facility upgrades.	1 – 10%	3 – 12 months	\$1,000K – \$2,000K	Baseline includes funds for seismic upgrades identified in NPH Assessment to meet PC-2 DBE. No further action.	Unchanged
Phase I Safety System Assessment - DNFSB 2000-2 Recommendation (Appendix D)	DOE requires a Phase II assessment of fire protection system or other safety system	Delay in CD-2 to perform assessment	11 – 25%	1 – 2 months	\$100K – 200K	Phase I assessment determined Phase II not necessary. No further action.	Unchanged
REVS Evaluation– DNFSB 2004-2 Recommendation (Appendix F)	Analysis identifies need for additional administrative actions (e.g., procedures, engineering documentation, etc.).	Additional procedures, engineering documentation, etc.	26 – 75%	0 – 3 months	\$100K – \$200K	Perform DNFSB 2004-2 safety performance analysis and report (ongoing – 4/20/07 completion).	Unchanged
	Analysis identifies required ventilation system upgrades.	Additional facility upgrades.	1 – 10%	3 – 12 months	\$500K – \$2,000K	Perform DNFSB 2004-2 safety performance analysis and report (ongoing – 4/20/07 completion).	Unchanged
Safety Design Strategy	Requirements for risk-informed approach to development of the 325 Building safety basis is not well defined (e.g., standards, requirements and expectations for 325 Building DSA/TSRs not clearly defined and understood).	Impacts schedule for approval of safety basis, facility scope, design.	26 – 75%	6 – 9 months	\$3M – \$5M	DOE-SC provides safety basis expectations early for risk-informed approach. Continue to work closely with DOE-SC on risk-informed approach to safety basis for such facilities.	Unchanged

Table 6. (contd)

Source of Risk	Project Risk	Project Impact	Likeli-hood	Schedule Impact	Cost Impact	Mitigation Actions	Residual Risk
	325 Building design requirements are not acceptable to DOE (because of evolving requirements, particularly evolving safety requirements).	Delay in completion of design – will have to do some redesign.	1 – 10%	0 – 3 months	None	Review new DOE requirements. As new DOE requirements are entered into PNNL's contract, they will be reviewed for applicability to design. Baseline change control will be used to identify impacts, including costs.	Unchanged
	325 Building RA scope and process have not been defined.	Impacts effort to prepare for ORR and RA.	76 – 90%	3 – 12 months	None	Development of Readiness Plan in coordination with DOE and well in advance of Readiness Activity (develop Plan, obtain DOE buy-in/approval in FY 2007). Work closely with SC on risk-informed approach to safety basis for such facilities.	Likelihood (11 – 25%) Schedule Impact (0 – 3 months) Cost Impact (None)
	Significant RA prestart findings delay completion of the 325 Building RA.	Delays startup (transition) of the 325 Building extended mission.	1 – 10%	0 – 3 months	\$100K – \$500K	Conduct rigorous management self assessment. Early involvement of Safety Basis Review Team has already reduced likelihood of a significant finding.	Unchanged

Table 7. Composite Risk Assessment of Proposed Modifications

Safety Assessment	Planned Path-Forward (proposed modifications)	Risk Type							
		Off-Site Dose Consequence Impact	**Worker Safety Impact**	**Extended Facility Life Impact**	**Conduct of Operations Impact**	**Programmatic Impact (R&D Mission)**	**Perceived Public Risk**	**Cost Impact**	**Project Risk**
Reduce Facility and Area Inventory Limits	Reduce ^{3}H TSR Limits.	Bounding Offsite Dose Reduced 66 % (4.7 Rem to 1.6 Rem)	None	None	None	None	Positive Change (lowered allowable quantity of radioactive material)	< $100 K (Revised TSR implementation)	None
Major Modification Determination	Proposed 325 Building modifications are not a major modification.	None	None	None	None	None	None	None	Low
NPH Update	Implement upgrades to bring 325 Building into compliance with PC-2 criteria for the PC-2 DBE.	None	Minimal Positive (during DBE)	None	None	None	Positive Change (greater assurance of complying with DBE criteria)	$2.6M (DBE seismic upgrades)	Low
Scoping Hazards Analysis	Make hot cell and gloveboxes SS DFs.	None	Positive (SS DFs)	None	Negative (Compliance with DF documentation)	Negative (Compliance with DF documentation)	Positive Change (SS DFs subjected to higher level of design assurance)	Included in $3.1 million DSA development	Medium (new SS SSCs or ACs)
DOE Safety Requirements Review	Meet requirements for specific administrative controls (SACs) and implement revised functional classification strategy.	Minimal Positive (new SACs)	Minimal Positive (new SACs or ACs)	None	Minimal Negative (Compliance with SACs)	Minimal Negative (Compliance with SACs)	Positive Change (increased level of review and oversight)	Included in $3.1M DSA development	Low
Phase I Safety System Assessment (DNFSB 2000-2)	Phase II assessments not needed.	None	None	None	None	None	None	None	High (Phase II assessment decision by DOE)
REVS System Assessment (DNFSB 2004-2)	Cost/benefit assessments not needed.	None	None	None	None	None	None	None	Low (based on early results of assessment)
Safety Design Strategy	No specific recommendations.	None	None	None	None	None	None	None	High (Risk-informed approach & undefined RA process)

8.0 Risk Assessment Conclusions

The major conclusion of this assessment is that the 325 Building can continue to operate safely for an extended 20-year life following completion of the planned PSF Project 325 Building modifications. This conclusion is based on the following:

- All proposed facility, system, and DSA modifications have been included in the PSF Project work scope.
- There are no other major investments anticipated for the 325 Building in the out years. A comprehensive effort to assess the 325 Building structures and systems identified no programmatic need for additional upgrades beyond those already planned in the PSF Project.
- The PNNL F&O organization has certified that routine and preventive maintenance programs will be fully funded through the annual operating budgets for the extended 20-year operating life of the facility (CRL-RPT-PM-001). Maintenance includes routine, recurring and non-recurring, and large non-recurring maintenance of SSC.
- The upgraded DSA will show that continued operation of the 325 Building will meet DOE-SC expectations for operation of a HC-2 nuclear facility.

9.0 References

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